Patent Claims

1. Electrotherapy apparatus comprising a sensor for detecting periodically recurring signal peaks, for example the R-R peaks of an electrocardiogram of a person, a processor for deriving from said periodically recurring signal peaks a time delay corresponding to approximately the end of the T-wave, a trigger system or a circuit initiated by an output signal of said processor or embodied within said processor for applying electrical stimulations to one or more active electrodes provided on the said person at a time related to the end of said time delay,
characterized in that
the processor is adapted

   a) to make a determination for successive pairs of signal peaks of a value corresponding to the time between said successive pairs of signal peaks and thus to the said person's heart rate,

   b) to compare said value with maximum and minimum permissible technical limits permitted by the apparatus and/or

   c) to compare said value with maximum and minimum permissible selected limits,

   d) to determine whether each said value exceeds a preceding value or a preceding value averaged over a plurality of heart beats by more than a defined amount,

e) to determine whether each said value is less than a preceding value or a preceding value averaged over a plurality of heart beats by more than a defined amount, and

f) to trigger said trigger system or circuit only when the comparisons b) and/or c) are favourable and the determinations d) and e) show that the said value does not exceed the preceding value or the preceding average value by more than the defined amount and is not less than the preceding value or the preceding value by more than the defined amount.

2. Electrotherapy apparatus in accordance with claim 1, characterized in that
the processor is adapted to close a measurement window for said sensor once a determination is made that the comparisons b) and/or c) are favourable and that the determinations d) and e) show that the said value does not exceed the preceding value or the preceding average value by more than the defined amount and is not less than the preceding value or the preceding average value by more than the defined amount, said measurement window being closed prior to triggering said trigger system.

3. Electrotherapy apparatus in accordance with claim 1 or claim 2, characterized in that
said processor is adapted to calculate in addition to said time delay a maximum stimulation length.

4. Electrotherapy apparatus in accordance with claim 3, wherein said processor is adapted to check that the derived value of said time delay is greater than or equal to a delay time equivalent to a trigger

delay plus a calculated delay, said trigger delay being the delay between initiation of a trigger signal delivered by said sensor corresponding to the detection of a first signal peak and the time this signal reaches the processor and the calculation delay being the time required by the processor to calculate the delay, said processor also being adapted to check that the calculated time delay is less than or equal to said maximum stimulation length and to revise said calculated time delay if necessary so that it fulfils the two conditions calculated time delay greater than or equal to the trigger delay plus the calculation delay and calculated time delay less than or equal to the maximum stimulation length.

5. Electrotherapy apparatus in accordance with claim 4, characterized in that
the processor is adapted to calculate a maximum duration equal to the maximum stimulation length minus the time delay.

6. Electrotherapy apparatus in accordance with claim 5, characterized in that
said processor is adapted to calculate a duration of said electrical stimulation and a maximum duration value equal to said maximum stimulation length minus said calculated time delay and to check whether said calculated duration is less than or equal to said maximum duration and if not to adapt it so that it is less than or equal to said maximum duration.

7. Electrotherapy apparatus in accordance with claim 6, characterized in that
said processor is adapted to calculate an open measurement window time equal to said calculated time delay, or said adapted delay,

if said delay has been adapted, plus said duration or said adapted duration, if said duration has been adapted, plus a safety margin.

8. Electrotherapy apparatus in accordance with claim 7, characterized in that said processor sends an output signal to said trigger system during said measurement window and opens said measurement window at the calculated time permitting the recognition of the detection of a further peak of said electrocardiogram by said sensor.

9. Electrotherapy apparatus in accordance with claim 8, characterized in that said processor is adapted to repeat the sequence of steps based on the new R-R value.

10. Electrotherapy apparatus in accordance with claim 9, characterized in that if a further signal peak is not detected after opening of said measurement window within an expected time calculated by said processor based on a preceding value or a preceding average value, no trigger signal is transmitted and transmission of a trigger signal and thus stimulation is inhibited until further signal peaks are detected within expected limits.

11. Electrotherapy apparatus in accordance with any one of the preceding claims, characterized in that instead of using a value of the preceding time between signal peaks as said value an average is formed from a plurality of past values.

12. Electrotherapy apparatus in accordance with claim 11, characterized in that
the processor is adapted to include in said plurality of past values only those values which lie within a range less than the preceding measured value plus a predefined positive deviation and more than a value corresponding to the preceding measured value less a predefined deviation.

13. Electrotherapy apparatus in accordance with any one of the preceding claims,
characterized in that
the apparatus has a plurality of channels for applying electrical stimulations to one or more active electrodes provided on the said person and in that for each said channel a respective offset value is added to said delay.

14. Electrotherapy apparatus comprising a sensor for detecting periodically recurring signal peaks, for example the R-R peaks of an electrocardiogram of a person, a processor for deriving from said periodically recurring signal peaks a time delay corresponding to approximately the end of the next T-wave, a trigger system or circuit initiated by an output signal of said processor or embodied within said processor for applying electrical stimulations to one or more active electrodes provided on the said person at a time related to the end of said time delay,
characterized in that
the apparatus has a plurality of output channels for applying electrical stimulations to said one or more active electrodes provided on the said person.

15. Electrotherapy apparatus in accordance with claim 14, characterized in that for each said channel a respective offset value is added to said delay.

16. Electrotherapy apparatus in accordance with claim 14, characterized in that a plurality (Y) of channel groups (A, B; A, B, C) is provided, each channel group (A, B; A, B, C) comprising a plurality of channels.

17. Electrotherapy apparatus in accordance with claim 16, characterized in that each channel group (A, B; A, B, C) has the same number of channels (Ch.1, Ch. 2, Ch. 3, Ch.4 (Group A); Ch. 5, Ch. 6, Ch. 7, Ch. 8 (Group B); Ch. 9, Ch. 10, Ch. 11, Ch. 12 (Group C)).

18. Electrotherapy apparatus in accordance with claim 17, characterized in that means are provided for providing each channel group (A, B; A, B, C) with the same time delay.

19. Electrotherapy apparatus in accordance with claim 17, characterized in that
means are provided for providing each channel group (A, B; A, B, C) with a respective time delay generally different from time delays associated with other channel groups.

20. Electrotherapy apparatus in accordance with claim 19, characterized in that
the processor is adapted to provide a said time delay for one group of channels (A) and to add a respective time offset to said time delay for each further channel group (B; B, C).

21. A method of treating a person or a mammal using electrotherapy apparatus in accordance with claim 14 or claim 15, characterized in that
each output channel provides a respective time delay generally different from a time delay associated with any other output channel and that the output channels are either all connected to a common electrode affecting a particular muscle or muscle group or are connected to respective electrodes each affecting a respective muscle or group of muscles.

22. A method of treating a person or a mammal using electrotherapy apparatus in accordance with any one of claims 16 to 20, characterized in that
each channel group of output channels is associated with a group of muscles in general proximity to one another on a body of said person or mammal, with the group of muscles associated with each group of output channels being the same group of muscles for each group of output channels, and in that the stimulation signals transmitted via each group of output channels is offset time-wise in relation to stimulation signals transmitted by any other group of output channels.

23. A method of treating a person or a mammal using electrotherapy apparatus in accordance with any one of claims 16 to 20, characterized in that
each channel group of output channels is associated with a respective group of muscles in general proximity to one another on a body of said person or mammal, in that the group of muscles associated with one group of output channels differs from a group of muscles

associated with any other group of output channels, and in that the stimulation signals transmitted from each group of output channels to the respectively associated group of muscles are triggered at the same time for each group of channels.

24. A method of treating a person or a mammal using electrotherapy apparatus in accordance with any one of claims 16 to 20, characterized in that
each channel group of output channels is associated with a respective group of muscles in general proximity to one another on a body of said person or mammal, in that the group of muscles associated with one group of output channels differs from a group of muscles associated with any other group of output channels, and in that the stimulation signals transmitted from each group of output channels to the respectively associated group of muscles are triggered at different times for each group of channels.

25. A method in accordance with claim 24,
characterized in that
the groups of muscles respectively associated with each group of channels are disposed on a body of said person or mammal such that a group of muscles closer to the heart and associated with one group of channels is stimulated later than a group of muscles disposed further from the heart and associated with another group of channels.

26. A method in accordance with claim 24,
characterized in that
the groups of muscles respectively associated with each group of channels are disposed on a body of said person or mammal such

that a group of muscles further from the heart and associated with one group of channels is stimulated later than a group of muscles disposed closer to the heart and associated with another group of channels.

27. A method in accordance with claim 25 or claim 26, characterized in that
the first group of channels comprises four channels associated with four active electrodes, namely first and second active electrodes disposed over the lateralis muscles at the left and right front sides of the human body, and third and fourth active electrodes disposed over the glutea muscles disposed at the rear of a person's body to the left and right thereof, with passive electrodes being disposed over the infra inguinalis muscles provided at the left and right at the front of the human body, in that the second group of channels comprises four channels associated with four active electrodes, namely first and second active electrodes disposed over the femoralis medialis muscles on the left and right thighs at the front of the human body, and third and fourth active electrodes provided over the sulcus glutealis muscles beneath the left and right buttocks, with passive electrodes being provided above the supragenus muscles above the knees and in that
the third group of channels comprises four channels associated with four active electrodes, namely first and second active electrodes provided above the medialis muscles below the left and right knees, and third and fourth active electrodes being provided over the lateralis muscles on the left and right calves, with passive electrodes being provided above the doralis pedis muscles on the left and right feet.

28. Electrotherapy apparatus in accordance with any one of the preceding claims 1 to 20,
characterized in that
said sensor is a non-electric sensor, or a non-electric sensor used in addition to an electrocardiograph.

29. Electrotherapy apparatus in accordance with claim 28,
characterized in that
said non-electric sensor is selected from the group comprising a non-invasive, aortic pressure measurement device, an invasive aortic pressure measurement device and a noise detection device adapted to detect the closing of the heart valves.